

Dillon Aero Minigun

He who shoots the most the fastest wins.

By Doug Larson

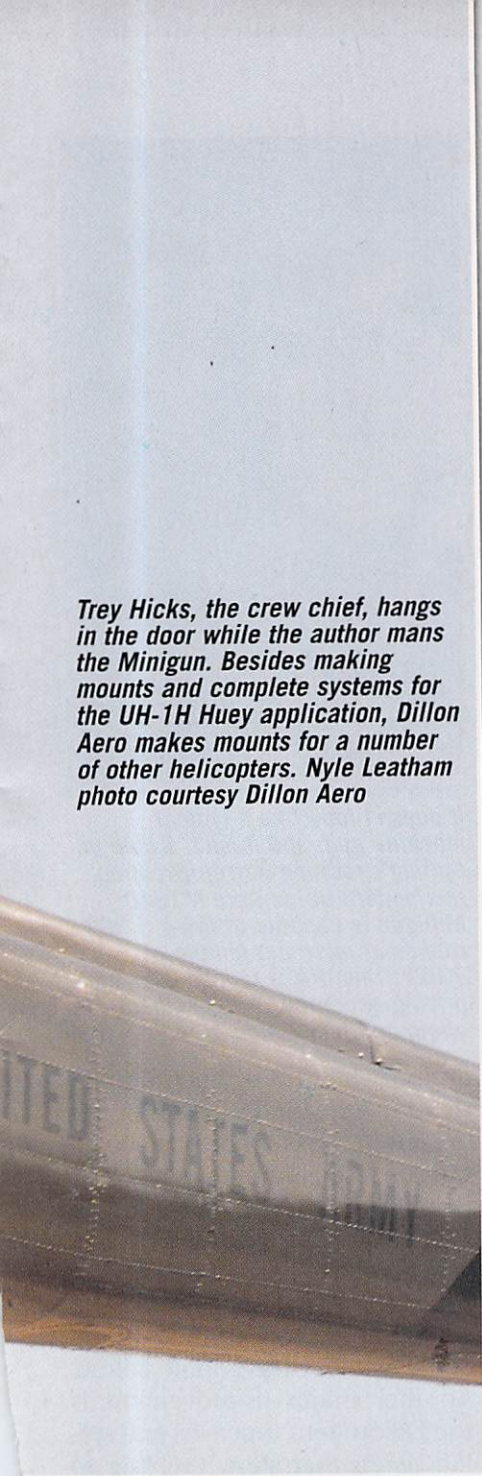
In a firefight, the side that sends the most bullets to the target first usually wins, so having a weapon that fires 50 rounds per second is a gigantic advantage. I got to see that advantage first-hand while firing Dillon Aero's M134D Minigun from the door of a vintage Huey

helicopter as we sped along over the Arizona desert.

Mike Dillon, founder of Dillon Precision, the renowned builder of reloading equipment, has long had a keen interest in machine guns. In the mid-1980s he added a General Electric Minigun to his sizeable collection. As he got

acquainted with it he found many reliability problems, especially with the delinker, so he set out to see if he could make the gun work better—not for profit but to relieve frustration created by frequently having to clear stoppages.

Initially, Mike put a hatch on



Trey Hicks, the crew chief, hangs in the door while the author mans the Minigun. Besides making mounts and complete systems for the UH-1H Huey application, Dillon Aero makes mounts for a number of other helicopters. Nyle Leatham photo courtesy Dillon Aero

the delinker so that ammunition-feeding jams could be cleared without having to disassemble it. This was a major improvement because before, fixing a jam meant taking the delinker apart, which left many small pieces laying around that could get lost. This made clearing a jam on an aircraft nearly impossible, often resulting in a return to base and

putting an important asset out of service.

Improving the delinker was just the first step of many. Now Mike's company, Dillon Aero, located in Scottsdale, Arizona, is the manufacturer of complete Miniguns and also makes upgrade parts for the GE originals.

Puff the Magic Dragon

The GE Minigun is a descendant of the famous Gatling gun that was invented by Richard J. Gatling in the mid-1800s. General Electric used Gatling's rotating, multi-barreled concept to develop the Vulcan in the mid-1940s by adding an electric motor and other refinements. The Vulcan was designed to fire 20mm cannon rounds, but in the 1960s the military saw a need for a similar gun firing smaller rounds. One was built chambered in 7.62x51mm NATO, hence the moniker "Minigun." Later designated the GAU 2B or the M134, GE's Minigun was first test-fired in 1962. Soon it was put to use in several applications in Vietnam, one of the most famous being side-mounted in a C-47 aircraft, designated the AC-47 and used for air-to-ground fire. It earned the nickname Puff the Magic Dragon because of the stream of fire it seemed to produce when shot at night.

Minigun rates of fire vary, and some have been reported as high as 10,000 rounds per minute, but the Dillon crew has found 3,000 rpm to be very effective, delivering controllability and good shot density while at the same time conserving ammunition (if you can call 50 rounds per second conservative). If you have a need for more speed, an optional 4,000-rpm gear drive is available.

The Minigun is electrically driven using either AC or DC power, although most applications use 24 to 28 volts DC, which is standard aircraft voltage. The gun can be mounted to

an aircraft in a fixed forward-fire mode or on a side mount that allows directional fire by a gunner. Being a suppressive-fire weapon, it delivers high shot density very quickly for destroying or incapacitating multiple targets. In other words, it puts a lot of rounds in a small area in a hurry, creating a very intense hailstorm of hot lead.

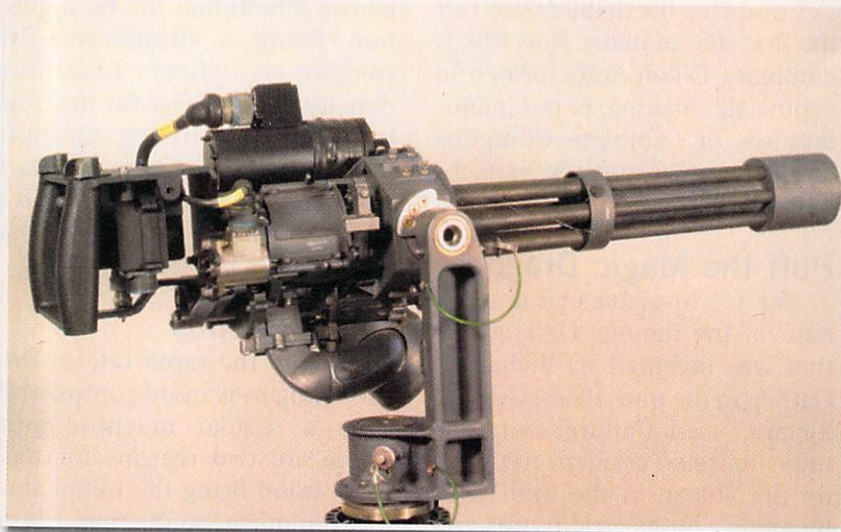
Controllability

Despite the rapid rate of fire, the Minigun is more controllable than a regular machine gun. There are two reasons for this. First, upon firing the initial shot the gun moves to the rear, where it stays. There is no time for it to move forward between shots because the time between them is so short—about 1/50th of a second. Consequently, there is no up-or-down movement either, and since the gun just moves back in its mount, the gunner does not need to constantly correct for recoil, making it easier to aim and hold on target.

Second, about four rounds are fired in the time it takes to fire one round from a machine gun like the M240, so the gunner sees four times as many hits on the target, giving him more feedback with which to adjust aim. Essentially, it reduces the time to a quarter of what he usually needs to see hits and make corrections. This is particularly important in aerial applications because between each bullet impact, the gun and the target may move. The less time between impacts, the shorter distance the gun and target move, requiring smaller adjustments that can be made faster with less error.

Tests conducted by Dillon Aero show that the Minigun scores on average nine times more hits on target than the M240 even though the rate of fire is only four times, not nine times faster. This is due to the combined effects of weapon stability

Dillon Aero Minigun



The Dillon Aero M134D Minigun is derived from the original Minigun built by General Electric. It fires 3,000 rounds per minute—an incredible 50 rounds per second—and the mean rounds between failures is 30,000.

and resultant density of the shot group.

Ammunition is delivered to the gun using standard M-13 disintegrating-link ammunition belts routed through a feed chute that attaches to a magazine containing 1,500, 3,000 or 4,400 rounds. Dillon Aero magazines have two internal bays and a baffle that prevents cartridges from interlocking, allowing belts to feed smoothly—a critical factor in reducing stoppages.

Improvements

The original General Electric Minigun's MAU-56 feeder/delinker, as previously mentioned, was a weak point in the system. If it malfunctioned, clearing could take between 10 and 20 minutes and might take the gun out of service for a complete overhaul. Dillon Aero's DAFD2000-1 feeder/delinker is the single most important system improvement. Like the old MAU-56, its purpose is to delink ammunition and feed delinked rounds to the gun, but Dillon Aero's delinker is vastly improved. It retains lube, channels dirt and debris away from critical areas and features two

hatches, allowing access to the interior in order to clear jams in less than 60 seconds. Tests show that the mean time between feeder/delinker failures is 500,000 rounds.

A Minigun does not need electrical power to fire; rotation of the barrels alone will ignite any rounds in the chambers. Therefore, for safety reasons Miniguns are designed to leave no rounds in the gun once the fire control button is released. The original GE guns did this by engaging a gate in the feeder/delinker that diverted live rounds from the gun and dumped them overboard, wasting six to 12 rounds every time the firing sequence was stopped. Even though magazine capacities were large, ammunition was expended rapidly, so wasted ammo could severely reduce the time a gun could be used before an aircraft had to return to base to reload.

Dillon Aero's DAC3000 Clutch Assembly, modeled after GE's clutch, solves this problem by stopping the delinker before the barrels stop rotating, thereby interrupting the supply of fresh



It doesn't look like a typical machine gun, and it isn't. Based on Gatling's rotating-barrel invention, the modern Dillon Aero M134D Minigun is capable of firing 3,000 rounds or more per minute of 7.62x51mm NATO rounds with surprising accuracy. Nyle Leatham photo courtesy Dillon Aero

ammo while the rounds already delivered are fired. No live rounds are left in the chambers, so cook-offs are also eliminated.

Dillon Aero bolts have longer expected service lives than the old GE bolts and also have a rounded firing-pin tip to prevent primer punctures, a problem that could lead to catastrophic failure. Another major improvement is the Dillon Aero topcover and safing sector that allow the user to "safe" the gun and visually verify that chambers are empty in seconds without disassembling the gun, as was necessary with the old GE system.

The gun control unit equipped with spade grips allows operation by an individual gunner but differs from a typical spade grip with a butterfly trigger in that it contains a guarded master power switch that charges the circuits, making the gun hot, and the trig-

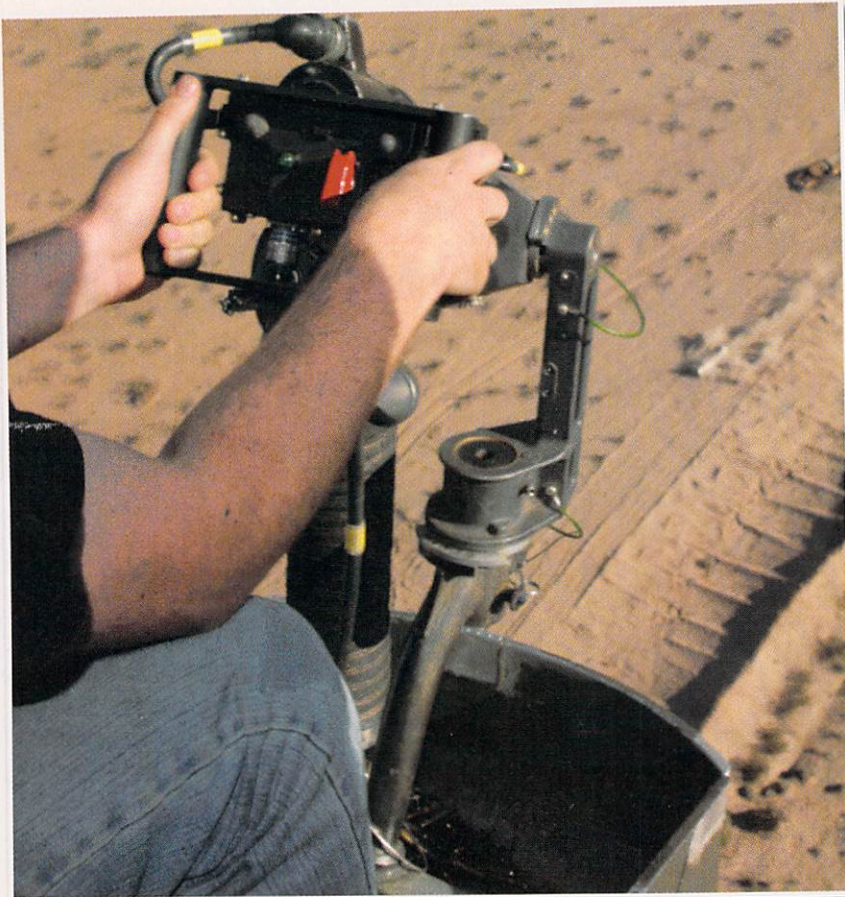
ger is actually two thumb-activated buttons, either one of which fires the gun. The GCU can also be fitted with an intercom-system push-to-talk button.

Dillon Aero Miniguns have a one-piece flash suppressor that fits over the ends of the barrels, clamping them in place. This is an important part, not only because it enhances accuracy by holding the barrels in proper alignment but also because muzzle flash from a Minigun can be quite distracting to the gunner and a real attention-getter, disclosing the gun's location.

Dillon Aero also sells modernization kits for old, legacy General Electric GAU-2B and M134 Miniguns, many of which sit unused because of lack of parts and poor reliability. The upgrade kits include the feeder/delinker, clutch assembly, bolt assemblies and removable tracks, gun control unit, spade grip, gun drive motor, 3,000-round gear head, topcover and safing sector, and one-piece barrel clamp/flash suppressor.

A standard M134D Minigun is constructed of steel components, but Dillon Aero developed a model with a titanium rotor, housing, feeder/delinker and flash suppressor to save weight—something especially important for aerial applications. While the standard steel gun assembly weighs 29.12 pounds, the titanium gun comes in at 20.8 pounds, more than eight pounds less.

Another weight-saving option is an 18-inch instead of the standard 22-inch phosphate-finished, four-groove, right-hand, 1:10-inch-twist barrels. Many might think that a reduction of four inches in length will result in a significant loss of muzzle velocity, but that is not the case. A rough rule of thumb is that one inch of barrel length adds only about 25 fps to velocity, so a



In this high-angle attack, bullet impacts are clearly seen on target. With 50 rounds per second, even if some slugs are slightly off the mark enough bullets will find the target to destroy it.

reduction in barrel length of four inches reduces muzzle velocity by only about 100 fps, and that's insignificant for a 2,800-fps projectile.

Also, according to Mike Dillon, shorter barrels seem to be more accurate. This is probably because with the shorter length, tolerances in the barrel/rotor and barrel/flash suppressor interfaces produce less wobble because with the shorter distances between the breach and the suppressor attachment point, the barrels are held more tightly in place.

A Minigun has no safety switch in the traditional sense and instead has a hatch called the safing sector. To safe and clear the gun, point it in a safe direction, then manually rotate the barrels

clockwise (as viewed from the rear of the gun) one barrel position. With the older Dillon Aero version the next step was to open the topcover, then the safing sector. With the new blade-type safing sector, only the safing blade itself needs to be opened. Finally, manually rotate the barrels one complete rotation, checking and clearing each of the six chambers as they are exposed. Although Miniguns are electrically powered, they don't need electricity to operate, and just rotating the barrels by hand can fire the gun unless the safing sector is opened.

How It Works

So just how does the Minigun function, and why does opening the safing sector make the gun



The impact area is just a blur, attesting to the speed of the Huey. Somewhere in that dust cloud is a well-perforated target, either a 55-gallon barrel or the hulk of an old car.

safe? The bolts, one for each of the six barrels, move fore and aft along a track that is parallel to the centerline of barrel rotation. Each bolt has a roller-type cam follower that rides in a cam path running inside the circumference of the gun housing. This cam path causes the bolts to move back and forth in their tracks, chambering and extracting rounds in proper timing as the barrels rotate.

When the bolt has driven a round into the chamber, the bolt rotates and locks into the breach, at which time the firing pin, which is under spring tension, is released to strike the primer, firing the cartridge. Timing is such that once a bullet has cleared the barrel, the bolt rotates again but in the opposite direction, unlocking itself from the breach. It is then carried aft in its track by the cam path while it extracts the expended cartridge case, which is then ejected.

When the safing sector is

opened, it removes the portion of the cam path that drives the bolt forward, and if the bolt cannot be driven forward, the firing cycle is interrupted. Removing that portion of the cam path will also cause the gun to be damaged if power is applied, so the gun should never be powered when the safing sector or top-cover is open.

Loading is simple. First, attach the feed chute to the feeder/delinker, then open the feeder/delinker hatches. Feed the cartridge belt through the feed chute, then push the first round into the feeder/delinker with the single link leading—it won't go any other way. Next, hold the first cartridge in place with the right thumb and close the forward hatch, then hold that hatch closed with the left thumb and close the aft hatch. That's it, and once the safing sector is closed, the gun is capable of firing. Just flip the

guarded master power switch to On and press the Fire button.

Although a rail is available and an optical sight can be attached, Chris Dillon says a sight isn't of much use at ranges of 500 meters or less. This is because in a helicopter, the aircraft and maybe the target are moving so fast, it is difficult if not impossible to find the target in the sight before the firing opportunity has passed. It seems that letting the brain work by itself, much like happens when a quarterback on the move throws a football to a receiver, will generate a high rate of first-round hits on target. With just a little practice the brain figures out the leads, and once first-round impacts are evident, the gunner adjusts aim. At ranges more than 500 meters, a sight can be an aid to first-round hits, but no traditional sight has worked very well so far.

Dillon Aero manufactures a narrow-profile booster assembly that installs on top of the magazine and gives the ammo a push as it enters the feed chute, helping it make the long trip to the gun in certain applications. The company also makes a round repositioner that repositions any round in the ammo belt that may have moved forward or aft in the link during handling or transport and could cause a malfunction when entering the feed chute or port.

A safety device to be used during maintenance, hot-gun clearing or whenever the gun is armed but not in use is a bullet-trap assembly that attaches over the muzzle of the gun and safely traps fired bullets by shredding them on impact. Using Concept Development Corporation's patented Ballistic Media System, the trap will stop armor-piercing rounds fired at contact distance.

Dillon Aero manufactures helicopter mounts for the UH-1H Huey, Bell 212 X, UH-60 Black



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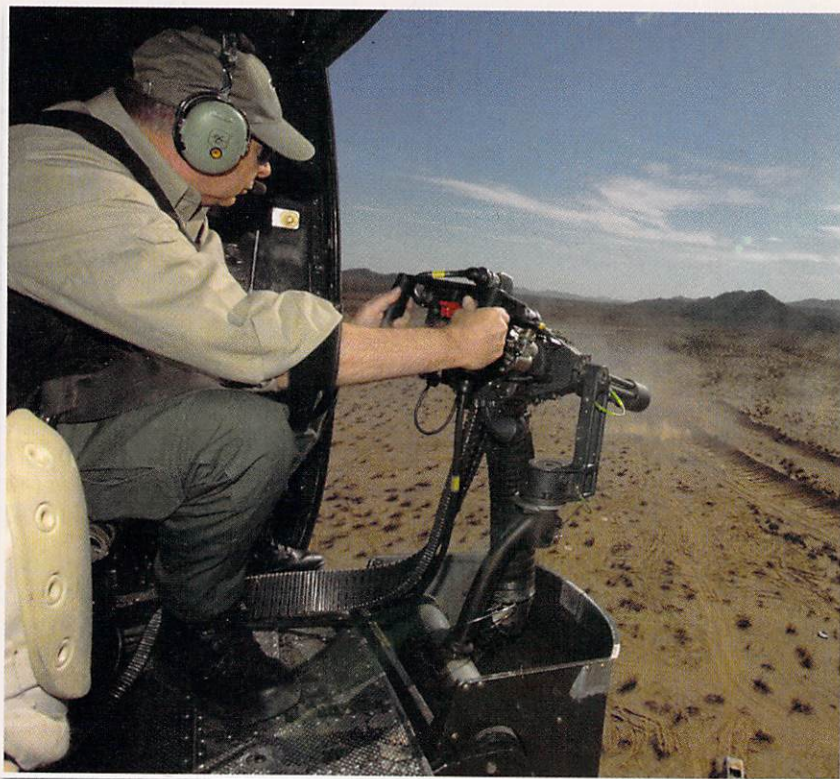
Hawk and MH-47 Chinook as well as a vehicle ring mount that can be utilized on a variety of ground vehicles including HMMWVs and any open-bed-type vehicle. The vehicle mount is equipped with composite Level 4-protection armor and allows the gun to be traversed 360 degrees. Also available is a Naval Post Mount for mounting an M134D on a deck.

Takedown Procedure

Disassembly of the gun for post-firing maintenance and cleaning is very simple. As with all guns, make sure it is pointed in a safe direction and unloaded. Safe the gun, then remove the feeder/delinker by first extracting the quick-release pin and then rotating the feeder/delinker away from the housing to the point that it will slide off the clevis pin. Next remove the flash suppressor, after which the barrels can be twisted about a half-turn and removed from the rotor. The topcover is then taken off by removing the quick-release pin, and using a 5/16-inch wrench, every other track is then removed, allowing the bolts to be retracted rearward where they can be lifted from the rotor. That's it. Assembly is in the reverse order.

Cleaning and maintenance take only five or 10 minutes. Maintenance consists of removing the old grease from the bolts and bolt tracks and replacing it with fresh TW25B. Solvent is rarely used. If the feeder/delinker is particularly dirty, the old grease may be removed and replaced, again with TW25B.

The barrels are never cleaned, and the set of six continue to work just fine up to their 100,000-round life. With 30,000 mean rounds fired between malfunctions and an estimated system life of 1½ million rounds, this cleaning regimen obviously works, even though some may think it is not thorough enough.



The impact area is fairly large and some rounds have missed the target, but with a rate of fire of 3,000 rounds per minute, enough bullets are hitting the mark to accomplish the goal of destroying it. Nyle Leatham photo courtesy Dillon Aero

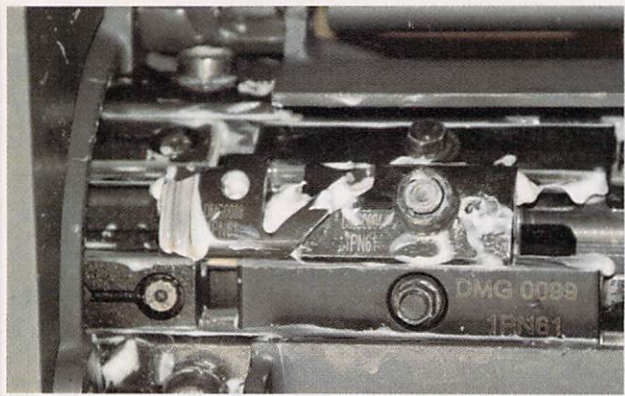
When I first peered inside the M134D, I noticed that a lot of grease had been generously applied to the bolt cams and tracks, so I asked Chris about the company's lubrication recommendations. He told me they run the gun wet, meaning plenty of TW25B is applied. The first time the gun is fired after application of the lube, the excess is thrown off and what remains is the right amount. As the gun is fired, dirt particles are suspended in the lube, and more lube is added as necessary to keep them suspended. If too little lube is used, dirt overwhelms it and the gun malfunctions.

The traditional way of applying lubrication sparingly because it supposedly attracts dust and dirt is wrong according to Chris, who told me, "Lube doesn't attract more dirt; it does, however, keep dirt and particles that the

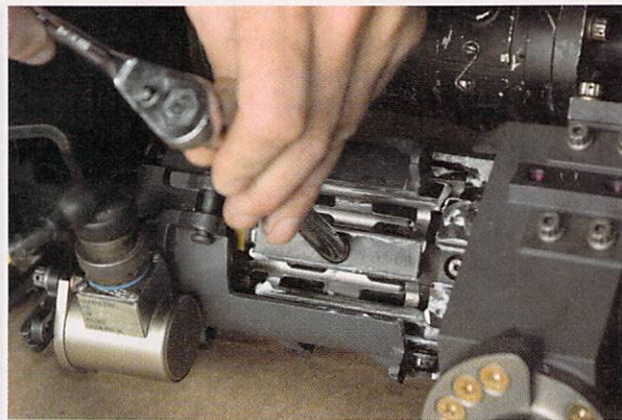
gun is exposed to suspended so they won't cause a malfunction." Whether or not you disagree, it works on these Miniguns and is the same method used to properly lubricate the M16/AR-15 family of guns.

The folks at Dillon Aero take their jobs seriously because lives depend on their product working right every time. To maintain quality, testing is constant, and besides, firing the Minigun is a lot of fun. On a private range about 45 minutes by helicopter outside of Phoenix, I got the chance to find out just how much fun it is and how well these improved Miniguns really work.

Upon arrival in Mike's restored UH-1H Huey helicopter, piloted by his son Chris, the ground crew mounted the Minigun and then loaded the 3,000-round magazine (which took more time than it would



Dillon Aero recommends large doses of the lubricant TW25B to keep the Minigun running smoothly. Although a departure from traditional thinking that advocates sparing use of lubricants, it works.



It takes only a few minutes to remove the bolt tracks with a socket wrench, after which the bolts can be removed for inspection and cleaning.

emptying it). After watching this operation, I donned a harness that tethered me securely by a cord to an anchor point inside the aircraft, allowing me to move around but keeping me from falling out of the open sides.

Rounds On Target

When we lifted off for the first

M134D Minigun

Maker:

Dillon Aero
800/881-4231
www.dillonaero.com

Action Type:....Rotating barrel, fully automatic, electrically driven

Caliber:.....7.62x51mm NATO

Rate of Fire:....3,000 rpm (4,000-rpm drive optional)

Capacity:.....1,500, 3,000 or 4,400 rounds

Feed System: ...Disintegrating-link belt

Barrel Length: 18 or 22 inches

Overall Length: 31.56 inches with long barrels

Weight:.....29.12 pounds (gun assembly only)

Sights:.....None

MSRP:.....\$53,000

run over the targets—a few empty automobile bodies and 55-gallon drums—I watched Trey Hicks, our crew chief and expert gunner, show me how it's done. Fast or slow, from high or low, he hit what he was aiming at and I hoped I wouldn't embarrass myself having to follow him.

After returning to the pad to reload, it was my turn. Talk about sensory overload—I had never shot anything from a moving vehicle, let alone a helicopter, so there was a lot for my feeble mind to process in a short period of time. Dillon gave the OK to arm the gun, and I remember closing the safing blade and flipping the main power switch on. From that point the first pass was and still is just a blur, but on the second pass I settled down and applied what shooting skill I had to the problem.

Since there were no sights, and remembering what I had been told about not overanalyzing the lead, I sighted over the barrel much like a shotgun. When it felt right, I pressed the Fire button and upon seeing bullet impacts, adjusted the lay as necessary. The technique worked pretty well. Within seconds it was time to engage the next target, though, because we were moving so fast—about 60 to 80 knots.

There was no perceptible recoil due to the sturdy Dillon Aero mount and because, just as I had been told, the gun moved backward once the first round was fired and the high rate of fire would not allow the gun to rebound forward until the Run button was released. It was easy to swing the gun and point it where I wanted it, and the mount restricted the range of travel so that it was impossible to shoot the helicopter itself or the rotors. In no time I had gone through 3,000 rounds, and it was time to fly back to the landing pad.

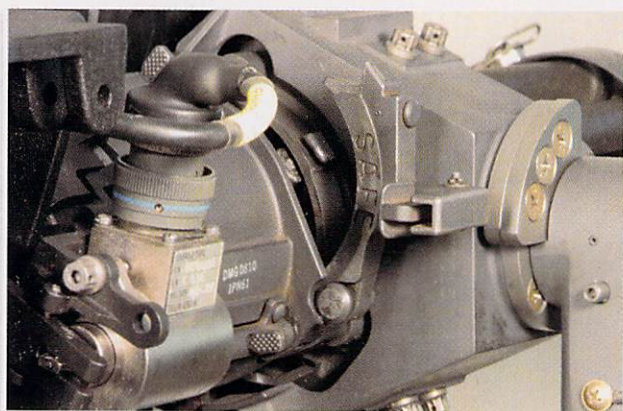
During the course of fire, we experienced a couple of malfunctions due to the quality of the surplus ammo used in testing. However, that allowed me to see that malfunctions really can be cleared in a matter of minutes and with no disassembly—something that would have been impossible with the legacy M134.

Mike told me, "I don't think—no, I know I would not have been able to design the original M134. I stood on the General Electric engineers' shoulders to improve the gun." He also told me that designing and refining the mount, case and link disposal, magazine, ammunition feed, electric and other systems that make the gun function properly

Dillon Aero **Minigun**



Once the flash suppressor has been removed, the barrels can be separated from the rotor by simply turning them about a half-turn and sliding them forward.



The word "safe" is visible when the blade-type safing sector is in the open position, which prevents the bolts from being driven forward into battery and firing the Minigun.

in a specific application take twice the effort in improving the gun itself. If just one part of the system doesn't work properly, the gun won't work either.

Dillon Aero now makes every part of the Minigun so that even an old GE gun, if it were com-

pletely upgraded including a titanium housing and rotor, would have no major GE parts left except for a few fasteners. That's a lot of improvements.

Dillon Aero does not sell complete systems or parts to civilians and is busy full time providing

Miniguns to the military. The M134D is used worldwide for convoy escort, border patrol and VIP protection and is in service with the Royal Navy and all branches of the U.S. military. It is also used on many helicopters, where it is a very effective

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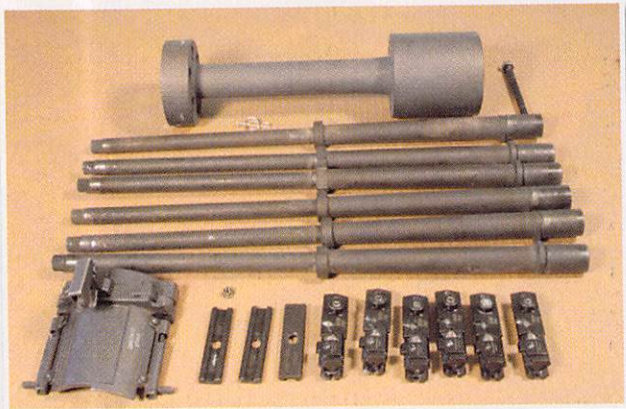
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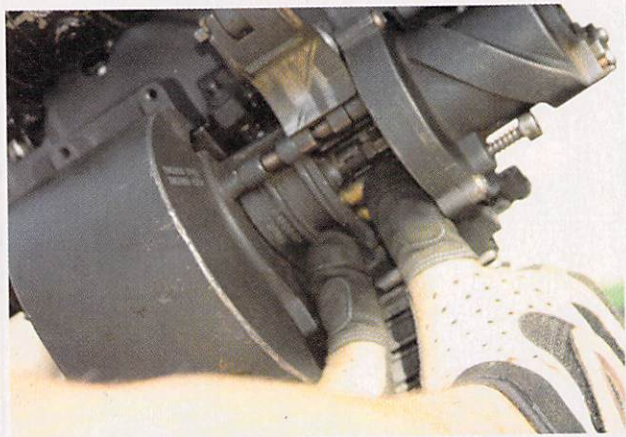
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There is not much to disassemble or clean in a Minigun. Once the flash suppressor/barrel clamp (at top) is removed, the barrels easily slip out of the rotor. The safing sector and topcover (bottom left) come off in seconds, after which the bolt tracks (bottom center) are removed and the bolts (bottom right) are lifted free of the rotor. Assembly is in the reverse order.



Once the cartridge belt has been fed through the feed chute, the first round of the belt is pushed into its slot in the feeder/delinker. The right thumb then holds the cartridge in place while the left thumb closes the forward hatch and holds it, after which the right thumb closes the rear hatch.

weapon. A complete system that includes the Minigun itself, magazine, ammunition feed system, power cables, mounts and other vital components without which

the gun will not run sells for approximately \$53,000, depending on the application.

He who shoots the most the fastest wins—that's the saying

around Dillon Aero. I think maybe he who shoots the most the fastest also has the most fun.

It's going to be hard going back to shooting popguns. ©

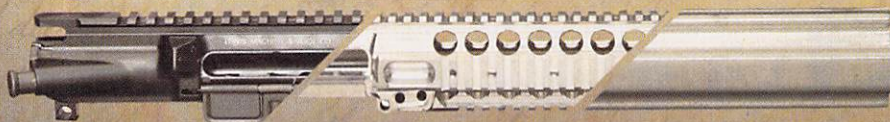
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